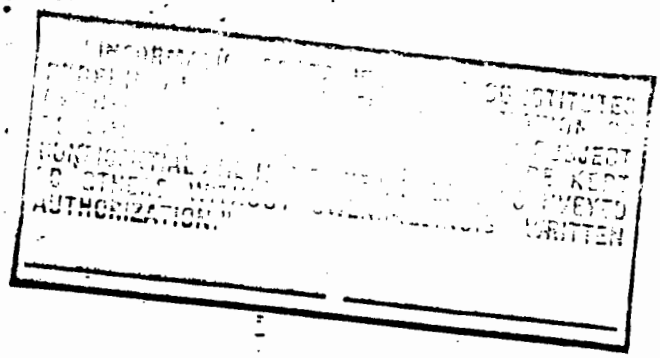
State of California
AIR RESOURCES BOARD

ENGINEERING EVALUATION BRANCH
Test Report No. C-85-019

Emissions from Glass Melting
Furnace #B at Owens-Illinois
Tracy, California



Report Date: July 1985

Approved:

A. C. Jenkins
Testing Section — Project Engr.,

_____
Testing Section — Manager,

Jean C. Summerhays
Engineering Evaluation Branch — Chief,

TABLE OF CONTENTS

SUMMARY

On May 7, and 8, 1985, staff of the Engineering Evaluation Branch performed tests to determine the emissions of selected heavy metals, in particular total chromium, hexavalent chromium and arsenic, from glass melting furnace # B at Owens-Illinois in Tracy, California. The test results for emissions of chromium, hexavalent chromium and heavy metals will be utilized in ARB's emissions inventory for toxic air contaminants. To allow the proper evaluation of the test results for emissions of heavy metals, the staff also performed tests to allow determination of emissions of sulfur dioxide (SO_2), oxides of nitrogen (NO_x), total hydrocarbons (HC), carbon monoxide (CO), carbon dioxide (CO_2), oxygen (O_2), and total particulate matter (PM).

The results of the total chromium, hexavalent chromium, and arsenic tests are shown below. The emissions may be influenced by different furnace maintenance schedules, different feed characteristics and feed rates, and different furnace operating conditions.

Average Emissions of Particulate Matter, Chromium, Hexavalent Chromium and Arsenic from the Furnace at Owens-Illinois, Tracy, California

	Particulate Matter (Pounds/Hour)	Total Chromium (Pounds/Hour)	Hexavalent Chromium (Pounds/Hour)	Arsenic (Pounds/Hour)
May 7	8.7	1.9×10^{-2}	7.2×10^{-6}	6.0×10^{-4}
May 8	a/	2.0×10^{-2}	7.0×10^{-6}	5.4×10^{-4}

a/ Particulate matter test on May 8, deemed invalid

The emissions of gaseous criteria pollutants and combustion gases, shown below indicated that the process was operating at a steady state throughout the test period. The average concentration data for the gaseous compounds are shown below.

Summary of Average Concentration Data for Criteria Pollutants and Combustion Gases

Date	PM Grains/ DSCF	O_2 Percent	CO_2 Percent	CO PPMV	SO_2 PPMV @3%O_2	NO_x PPMV @3%O_2	HC PPMV
5-7-85	0.06	10.5	7.6	50[a/]	185	800	1[b/]
5-8-85	[c/]	11.1	7.0	50	170	1030	1

I. INTRODUCTION

On May 7 and 8, 1985, staff of the Engineering Evaluation Branch (EEB) performed tests to allow the determination of selected gaseous compounds, total particulate matter, and selected heavy metal emissions from glass melting furnace # B at Owens-Illinois in Tracy, California.

Four total particulate matter (Method 5) tests were performed on the furnace. Also, two particle sizing tests were performed at the same time as the Method 5 tests.

The following ARB personnel participated in the emission test.

A. Jenkins	Project Engineer
J. LaBrue	Technician
B. Thoma	Technician
D. Warner	Technician
J. Rogers	Technician

a/ Trace concentrations only, at or below minimum detectable levels of 50 ppm CO.
b/ Measured as propane
c/ Particulate matter test on May 8, deemed invalid

Mr. Ernie Valis, Jr. was the company contact at the Tracy plant. Mr. Dick Russell of Owens-Illinois, Toledo, Ohio, observed the entire emissions test program.

II. PROCESS DESCRIPTION

Raw material used for typical green glass bottles are cullet, limestone, soda ash, and silica sand.

Owens-Illinois personnel assured the test group that process weight rates were constant throughout the entire test period. Typical process weight rates and other operating conditions for the furnace are shown in Table I.

The vented gas from the furnace was exhausted through a round (45" inch diameter) stack downstream of an induced draft fan.

Owens-Illinois has requested confidentiality for the plant's process information. The information contained in Table 1 will be released by the Engineering Evaluation Branch only if proper authorization has been obtained by the requestor.

TABLE 1

CONFIDENTIALITY HAS BEEN REQUESTED FOR THE INFORMATION ON THIS TABLE.

Production (TPD) 233 (May 7-8, 1955)

R.H. Russell
12/11/89

This production information should be considered confidential.
R.H. Russell 2/13/90

III. TEST PROTOCOL

A. EMISSIONS OF TOTAL PARTICULATE MATTER AND HEAVY METALS

Sampling for particulate matter was performed in accordance with California Administrative Code Section 94105 which incorporates by reference, "Method 5 - Determination of Particulate Matter Emissions From Stationary Sources". This test method is similar to the EPA Method 5 procedure for determining particulate matter emissions. The sampling probes were pyrex lined. The pyrex lined probes were preferentially used over stainless steel probes to avoid the possibility of chromium contamination of the sample stream by the probe.

The total particulate matter loading was determined at the Air and Industrial Hygiene Laboratory (AIHL) in Berkeley. These data include the probe rinse, filter catch, after filter rinse, and impinger catch.

The masses of hexavalent chromium (Cr^{+6}), total chromium (Cr), arsenic (As), iron (Fe), manganese (Mn), nickel (Ni), lead (Pb), and cadmium (Cd) were determined by analyzing the particulate matter collected on the Method 5 glass fiber filters and the probe rinse.

Metals analyses were performed at AIHL using the atomic absorption technique. The hexavalent chromium determination was made by AIHL using Cal-OSHA Procedure L-116.

B. GASEOUS EMISSIONS

Sampling for gaseous pollutants was performed in accordance with California Administrative Code Section 94114, which incorporates by reference "Method 100 - Procedures for Continuous Emission Stack Sampling". This test method is used for determining gaseous emissions from stationary sources.

For evaluating certain gaseous pollutant emissions, a sampling probe was inserted into the stack at the same level as the location of the particulate matter sampling. The stack was traversed with the gas sampling probe to determine if there was a non-homogeneous flue gas stream caused by stack damper location and induced dilution air. The stack gas composition was determined to be homogeneous. Therefore, a single point was selected for gas sampling.

The sampling assembly consisted of a stainless steel mesh screen filter protected by a stainless steel sheath on the front half, a stainless steel tube connecting the filter to a heated Teflon-lined flexible tube, and a Thermo Electron (TECO) Model 600 sample conditioner. After the conditioner, the sample line was connected to a parallel series of rotameters and then to the analyzers.

Sulfur dioxide concentrations were determined with a Western Research Model #711 UV continuous analyzer using an ultraviolet photometry technique. Oxides of nitrogen concentrations were determined using a Thermo Electron Model 10 chemiluminescent analyzer. Carbon dioxide (Anarad Model AR-500) and carbon monoxide (Beckman Model 864) concentrations were determined using non-dispersive infrared spectroscopy (NDIR). Oxygen content was determined using a Teledyne analyzer utilizing an electrochemical technique. Total hydrocarbon concentrations were determined using a Beckman Model 400 analyzer equipped with a flame ionization detector (FID). Data were recorded on strip charts and a Hewlett Packard data acquisition system. The controller for the data acquisition system is a HP Model 9825A calculator. The analyzers were calibrated in the EEB Sacramento facilities before the emissions test and in

the field before and after each test run. Test periods for the gaseous criteria pollutants were set to correspond with the test periods for the total particulate matter tests.

C. PARTICLE SIZE DISTRIBUTION

The techniques specified in "Operations Manual, Pilat Mark 3 (University of Washington) Source Test Cascade Impactor," May 1979 were used. The Pilat Mark 3 was manufactured by Pollution Control Systems Corp., 4350 Union Bay Place N.E., Seattle, WA 98105. The quartz filters ("substrates") for the Pilat were tared to the nearest 0.1 milligram (mg) after desiccation to constant humidity and temperature. The substrates were mounted in either of two matching Pilat Mark 3 cascade impactors. The impactor was mounted on a stainless steel probe attached to a sampling line coupled to a silica gel desiccating cartridge, and the same Method 5 control console used in other tests. A representative sampling point in each stack was chosen based on previous traverses and each particle sizing test was run at that point without moving the probe. Based on the initial conditions of each test, an isokinetic sampling rate was estimated and the sampling rate was held constant and independent of subsequent stack gas velocity variations.

After returning to Sacramento, the substrate and sampler were desiccated to constant humidity and temperature and final masses were measured to the nearest 0.1 mg. The tare masses were subtracted from the final masses and the results for each impactor sizing stage were calculated and plotted on log probability paper according to the operating manual mentioned above.

IV. TEST RESULTS

A. EMISSIONS OF TOTAL PARTICULATE MATTER AND HEAVY METALS

Stack gas conditions for each Method 5 test are shown in Table 2. These data, with appropriate gaseous pollutant data, were used to calculate pollutant concentrations and mass emission rates.

As shown in table 3, the concentration of total particulate matter from Method 5 tests PT-1 and PT-2 averaged 0.06 grains per dry standard cubic foot (gr/DSCF). These data include the probe rinse, filter catch, after filter rinse and impinger catch. The corresponding mass emission rates are shown in Table 4. Particulate matter test runs PT-3 and PT-4 collected 2.5 times more total particulate matter than runs PT-1 and PT-2. Post test disassembly and inspection of the PT-3 and PT-4 sample train, indicated that the sample probe heat tape adhesive decomposed at the elevated stack temperature ($570^{o}F$) and off-gassed into the sample train causing an increase in sample weight throughout the entire train. Additionally, PT-2 and PT-3 were run simultaneously precluding speculation that the inordinate amounts of sample weights in PT-3 and PT-4 were due to stack effluent.

The concentrations and corresponding mass emission rates for chromium (Cr) hexavalent chromium (Cr^{+6}) and arsenic (As), are shown in Tables 3 and 4. The total chromium emission concentration ranged from $1.37x10^{-4}$ to $1.47x10^{-4}$ gr/DSCF. The hexavalent chromium emission concentration ranged from $5.1x10^{-8}$ to $5.3x10^{-8}$ gr/DSCF. The arsenic emission concentration ranged from $3.66x10^{-6}$ to $5.06x10^{-6}$ gr/DSCF. The concentrations and corresponding mass emission rates for iron (Fe) manganese (Mn), nickel (Ni), lead (Pb) and cadmium (Cd) are shown in Tables 5 and 6. The consistency of

the concentrations and mass emission rates of selected heavy metals shown in Tables 2,3,4, and 5 indicate that the aforementioned particulate matter contamination in tests PT-3 and PT-4 did not adversely effect the heavy metals analysis.

Table 2

Stack Gas Conditions for Glass Furnace # B
at Owens-Illinois in Tracy, CA.

Date	Test	Time	Stack Gas Velocity (ft/sec)	Stack Gas Flow Rate (SCFM dry)	Moisture Content (% by Vol.)	Stack Gas Temperature (^{o}F)
5-7-85	PT-1	0819-1022	53.4	16179	10.1	577
5-7-85	PT-2	1316-1530	52.5	15992	10.6	565
5-7-85	PT-3	1316-1530	52.0	15559	11.0	579
5-8-85	PT-4	0806-1006	52.4	16057	10.6	561

C-85-019
ACJ 5-10-85

Table 3

Concentrations of Total Particulate Matter, Chromium, Hexavalent Chromium and Arsenic at the Owens-Illinois Glass Plant in Tracy, CA

Date	Test	Time	Concentrations (grains per dry standard cubic foot) Total Particulate Matter	Cr ($\times 10^{-4}$)	Cr^{+6} ($\times 10^{-8}$)	As ($\times 10^{-6}$)
5-7-85	PT-1	0819-1022	0.06	1.37	5.1	4.46
5-7-85	PT-2	1316-1530	0.06	1.37	5.3	3.66
5-7-85	PT-3	1316-1530	1/	1.47	5.3	5.06
5-8-85	PT-4	0806-1006	1/	1.44	5.1	3.94

1/ Total particulate matter tests PT-3 and PT-4 were deemed invalid.

C-85-019
ACJ 5-10-85

Table 4

Mass Emission Rates of Total Particulate Matter, Chromium, Hexavalent Chromium and Arsenic at the Owens-Illinois Plant in Tracy, CA

Date	Test	Time	Mass Emission Rate (Pounds per hour) Total Particulate Matter	Cr ($\times 10^{-2}$)	Cr^{+6} ($\times 10^{-6}$)	As ($\times 10^{-4}$)
5-7-85	PT-1	0819-1022	9.0	1.89	7.10	6.18
5-7-85	PT-2	1316-1530	8.3	1.87	7.30	5.02
5-7-85	PT-3	1316-1530	1/	1.97	7.10	6.74
5-8-85	PT-4	0806-1006	1/	1.98	7.00	5.43

1/ Total particulate matter tests PT-3 and PT-4 were deemed invalid

C-85-019
ACJ 5-10-85

Table 5

Concentrations of Iron, Manganese, Nickel, Lead and Cadmium
at the Owens-Illinois Glass Plant in Tracy, CA

			Concentrations (grains/dry standard cubic foot				
Date	Test	Time	Fe ($\times 10^{-5}$)	Mn ($\times 10^{-7}$)	Ni ($\times 10^{-6}$)	Pb ($\times 10^{-4}$)	Cd ($\times 10^{-6}$)
5-7-85	PT-1	0819-1022	2.15	8.15	1.45	1.78	8.28
5-7-85	PT-2	1316-1530	1.15	7.69	1.14	0.55	9.76
5-7-85	PT-3	1316-1530	3.40	13.10	1.82	2.18	9.18
5-8-85	PT-4	0806-1006	2.70	12.50	3.15	1.98	8.06

C-85-019
ACJ-5-10-85

Table 6

Mass Emission Rates of Iron, Manganese, Nickel, Lead, and Cadmium
at the Owens-Illinois Glass Plant
in Tracy, CA

Date	Test	Time	Mass Emission Rates (pounds per hour) Fe ($\times 10^{-3}$)	Mn ($\times 10^{-4}$)	Ni ($\times 10^{-4}$)	Cd ($\times 10^{-3}$)	Pb ($\times 10^{-2}$)
5-7-85	PT-1	0819-1022	2.98	1.13	2.01	1.15	2.46
5-7-85	PT-2	1316-1530	1.57	1.05	1.56	1.34	0.75
5-7-85	PT-3	1316-1530	4.54	1.74	2.42	1.22	2.91
5-8-85	PT-4	0806-1006	3.72	1.73	4.33	1.11	2.72

C-85-019
ACJ 5-10-85

B. GASEOUS EMISSIONS

The gaseous emissions were relatively steady during the two day test period. Average gaseous emissions concentrations for each total particulate matter test are shown in Table 7. Gaseous emissions concentrations, used to bracket and represent the stack conditions during the Method 5 tests, were selected to correspond to the furnace checker switching schedule. Checker switching was on a 30-minute clock hour schedule. Oxygen levels were steady at approximately 10.9 percent. Carbon dioxide levels were steady at approximately 7.3 percent.

Oxides of nitrogen emissions, reported as NO_2 at 3 percent O_2 averaged 875 ppm. Hydrocarbon emissions concentrations were 1 ppm. These total hydrocarbon emissions are in line with natural gas combustion processes. Carbon monoxide emissions concentrations were also found in trace quantities indicating essentially complete fuel combustion. Sulfur dioxide emissions, reported at 3 percent O_2 averaged 180 ppm.

C. PARTICLE SIZE DISTRIBUTION

The sample integrity of both particle size distribution tests A-1PT and A-2PT was destroyed during post test sample handling.

Table 7

Concentrations of Oxygen, Carbon Dixoide, Carbon Monoxide Sulfur Dioxide, Oxides of Nitrogen, and Total Hydrocarbons at the Owens-Illinois Glass Plant in Tracy, CA

			Concentrations					
Date	Test	Time	O_2 [a] percent	CO_2 [a] percent	CO[a] ppmv	SO_2[b] ppmv	NO_x [b] ppmv	HC[c] ppmv
5-7-85	PT-1	0819-1022	10.9	7.5	< 50[1]	180	850	1
5-7-85	PT-2	1316-1530	10.4	7.6	< 50[1]	185	745	1
5-7-85	PT-3	1316-1530	10.4	7.6	< 50[1]	185	745	1
5-8-85	PT-4	0806-1006	11.1	7.0	< 50[1]	170	1030	1

[a] The O_2, CO_2 and CO values were used to determine the molecular weight of the stack gas for the calculation of particulate matter grain loading and mass emission rate.

[b] SO_2 and NO_x data corrected to 3 percent O_2.

[c] Total hydrocarbon data reported as propane.

[1] Trace amounts (less than 50 PPM)

C-85-019
ACJ 5-10-85

AIHL LABORATORY ANALYSES

PARTICULATE EMISSIONS (METHOD 5)

STUDY/C# C85-019 LN 50721 ANALYTE: PARTICULATE MATTER

Project Engineer AL JENKINS PHONE 8- 473-6577

Name of Establishment OWEN-ILLINOIS GLASS PLANT, TRACY

Date Received 5-13-85 Date Analyzed 5-22-85 Date REPORTED

FIELD #	PROBE RINSE (mg)	FILTER (mg)	AFTER-FILTER RINSE (mg)	IMPINGER RINSE (mg)	CONDENSATE (IMPINGER CATCH) (mg)	TOT
PT-1	36.5	138.2	22.6	17.9	40.6	25
PT-2	22.3	138.2	25.5	6.3	35.0	22
PT-3	39.6	161.1	188.3	80.9	146.1	616
PT-4	38.5	155.8	206.0	54.0	128.4	582
H_2O (B)	1.7	200 cc				
ACTONE (B)	2.6					
CH_2Cl_2 (B)	2.3					
BLANK (Filter)	0.0					

SSD ☒
OTHER ☐ Page 1/2
TO: DEAN SIMEROTH

I.D. No.
B STUDY OR CONTROL NUMBER | C | 8 | 5 | - | 0 | 1 | 9 |

PROJECT ENGINEER AL JENKINS

e of Establishment OWENS-ILLINOIS GLASS PLANT

ess TRACY, CA.

Date this Report:

Mo.	Day	Yr
6 5	2 8	8 5

Lab. No. *Lab. Use Only*	SAMPLE NUMBER	Laboratory Results
0721		Sample # — total Cr(VI), ug
		PT-1 — 0.2
		PT-2 — 0.2
		PT-3 — 0.2
		PT-4 — 0.2
		BLANK — < 0.2
		PT-1-BFR — < 0.2
		PT-2-BFR — < 0.2
		PT-3-BFR — < 0.2
		PT-4-BFR — < 0.2
		water BLK — < 0.2
		acetone BLK — < 0.2
		CH_2Cl_2 BLK — < 0.2
		*Color mix — 0.4 $\frac{ug}{gm.}$ (iron chromite)
		* MATERIAL SAMPLE

tures of Chemists Involved: | Date | Signature of Supervising Chemist | Date

PAUL WONG — 5/22/85 — E Jung — 5-23-85

AIHL/ARB 3/84 8001-008
State of California

SSD ☐
OTHER ☐ Page 2/2

I.D. No.

STUDY OR CONTROL NUMBER | C | 8 | 5 | - | 0 | 1 | 9 |

PROJECT ENGINEER _____

me of Establishment OWENS - ILLINOIS GLASS PLANT

dress TRACY, CA

Date this Report:

Mo.		Day		Yr	

Lab. No. or Lab. Use Only	SAMPLE NUMBER	Laboratory Results	
50721		Sample #	total Cr (VI), ug
		PT-1 - Cond	<0.2
		2 - Cond	<0.2
		PT-3 - AFR	<0.2
		Cond	<0.2
		PT-4 - AFR	<0.2
		Cond	<0.2

natures of Chemists Involved: Date

Paul W 5/23/85

Signature of Supervising Chemist Date

E Jung 5-23-85

AIHL/ARB 3/84 8001-008
State of California - Department of Health Services

LABORATORY REPORT

CD ☐
SSD ☐
OTHER ☐ PAGE 1/2

I.D. No.

ARB STUDY OR CONTROL NUMBER C85-019 PROJECT ENGINEER A. J. JENKINS

Name of Establishment OWENS-ILLINOIS GLASS PLANT

Address TRACY, CA.

Date this Report:

Mo.	Day	Yr
06	14	85

Lab. No. For Lab. Use Only	SAMPLE NUMBER	Laboratory Results						
50721		— TOTAL UG PER FILTER —						
		Pb	Cd	Fe	Mn	Ni	As	Cr
	PT-1	697.5	31.5	39.9	3.2	4.8	15.16	520.75
	PT-2	207.0	35.7	24.4	2.9	4.6	12.27	498.25
	PT-3	780.0	29.4	72.8	3.4	5.0	15.32	488.25
	PT-4	750.0	28.8	65.1	3.6	5.4	12.91	523.25
	BLANK	< 12.5	< 0.6	< 3.0	< 1.3	3.8	0.01	< 6.30
		..... BLANKS						
	WATER	< 12.5	0.2	0.7	< 1.3	1.1	0.01	1.0
	ACETONE	< 12.5	0.1	4.2	< 1.3	0.3	< 0.01	1.3
	CH_2Cl_2	< 12.5	0.3	3.0	< 1.3	0.6	0.09	1.8

Signatures of Chemists Involved: PAUL WONG — Date: JUNE-12-85

Signature of Supervising Chemist: E Jung — Date: 6-13-85

LABORATORY REPORT

CD ☐
SSD ☐
OTHER ☐ PAGE 2/2

I.D. No.

RB STUDY OR CONTROL NUMBER C85-019 PROJECT ENGINEER A.J. JENKINS

me of Establishment OWENS-ILLINOIS GLASS PLANT

dress TRACY, CA.

Date this Report:

Mo.	Day	Yr

Lab. No. *or Lab. Use Only*	SAMPLE NUMBER	Laboratory Results						
50721		·····TOTAL UG PER SAMPLE·····						
		Pb	Cd	Fe	Mn	Ni	Cr	As
	PT-1-BFR	<12.5	1.0	44.5	<1.3	4.7	15.8	2.34
	AFR	<12.5	<0.6	29.1	<1.3	<3.8	<6.3	0.01
	COND	<12.5	<0.6	<3.0	<1.3	<3.8	<6.3	<0.01
	Imp. Rinse	<12.5	<0.6	18.9	<1.3	<3.8	<6.3	<0.01
	PT-2-BFR	<12.5	1.1	18.9	<1.3	3.5	17.3	1.53
	AFR	<12.5	<0.6	7.6	<1.3	<3.8	<6.3	0.03
	COND	<12.5	<0.6	<3.0	<1.3	<3.8	<6.3	0.07
	IMP. RINSE	<12.5	<0.6	16.4	<1.3	<3.8	0.5	<0.01
	PT-3-BFR	38.0	5.0	54.7	1.5	5.8	63.8	3.62
	AFR	<12.5	<0.6	20.1	<1.3	<3.8	2.0	0.07
	COND	<12.5	<0.6	73.0	<1.3	<3.8	15.5	2.18
	IMP. RINSE	<12.5	<0.6	18.2	<1.3	<3.8	0.8	0.07
	PT-4-BFR	23.0	2.7	40.5	1.3	10.7	37.5	2.50
	AFR	<12.5	<0.6	<3.0	<1.3	<3.8	1.8	0.15
	COND	<12.5	<0.6	1.7	<1.3	<3.8	2.8	0.85
	Imp. Rinse	<12.5	0.2	12.6	<1.3	<3.8	0.5	0.04
	Color Mix	<12.5	1.2	474.1	141.8	13.0	166.8	0.59

natures of Chemists Involved: Date

PAUL WONG 6-12-85

Signature of Supervising Chemist Date

E Jeung 6-13-85

AIHL/ARB 3/84 8001-008

State of California